American Telecommunications: and the Impact of Deregulation and Divestiture

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The purpose of this paper is (a) to survey the present American telecommunications landscape, (b) to discuss the impact of deregulation and divestiture, (c) to describe some of the most recent trends in U.S. telecommunications, involving competition in local service and local switching, and to contrast them with the trend towards centralized ISDN.

I. The Setting

"Laissez-faire" is a term discredited in America by 19th century robber barons and by its French linguistic roots. "Deregulation," on the other hand, has a more benign sound, since an aversion to the heavy hand of government regulation has been a theme on which wide part of the American political spectrum can agree as a general proposition, though rarely in a concrete case. In America, the accelerated penetration of electronic technology in the telecommunications sector coincided and interacted with an intellectual and political move towards laissez-faire in general. In Europe, the new technology is similarly available, but the ideological receptivity for new institutional arrangements is very different. To most Europeans, the clear trend of economic history has been towards increased forms of public control. The political left took the scientific inevitability of this progressive trend as dogma; the conservative right, though parts of it were fighting bitterly against public control, was in doubt of its own long term prospects in stemming the trend. Joseph Schumpeter, who expressed this pessimism, saw capitalism in a no-win situation: even if it was economically successful, it undermined in the process of its own foundations and was doomed. The American historical experience, for a long time, followed the

expected path from relatively unbridled laissez-faire capitalism, to the regulation of monopolies in the Progressive Era, to the New Deal regulatory system which expanded in the three decades following World War II. The unusual aspect of recent developments in regulatory policy is their reversal of this historical trend. They must be viewed as more than a course correction to offset some bureaucratic excesses; nor can they be properly understood as merely a pro-business restoration; nor as a mere political fashion, induced by post Vietnam and Watergate disillusionment with government. The American turn towards laissez-faire is a more fundamental movement, based on the intellectual acceptance of ideas critical of the ability and desirability of governmental economic spheres, ideas that have been embraced -- openly or unacknowledged -- by large parts of the intelligentsia, the middle class, the post-war baby-boom generation that is rising in all institutions, and of course by those economic interests who stand to gain from deregulation--which do not include the traditional firms of the telecommunications industry.

II. A Multitude of Regulatory Bodies

For all the talk of deregulation, the number of regulatory bodies is larger than ever. The basic framework of government involvement in U.S. telecommunications is complex. The public sector does not own or operate civilian telecommunications

services, except for a few small municipally-owned cable television operations, rural telephone systems, and educational television broadcasting stations.

Although almost all civilian telecommunications facilities are privately owned, their use is often -- but not always -- subject to licensing and regulatory oversight. These regulations are set on the federal, state, and occasionally local level.

Federal policy emanates mainly from the Federal Communications Commission (FCC), a body of five commissioners appointed by the President but independent of that office. It operates as a hybrid within the American constitutional order, with some legislative powers (adoption of regulations), some executive authority (enforcement of its rules), and some judicial powers (adjudication of cases). The Commission allocates frequencies and regulates all broadcasting, satellite, and other civilian uses of the electromagnetic spectrum. The FCC is also in charge of interstate telephony -- that is, transmissions from one state to another - and everything affecting interstate communications. The FCC has some jurisdiction over cable television (E.g., FCC v. Midwest Cable Co., 440 U.S. 369 (1979).

State regulatory commissions -- which also are usually independent in status -- play an important role in regulating intrastate telephone, and in some instances also cable television. Municipal authorities regulate cable television through their powers to grant franchises to lay cable in their streets.

On the executive level, the Commerce Department's National Telecommunications and Information Agency (NTIA) helps to coordinate the President's -- that is, the Executive Branch's -- overall telecommunications policy. It plays a role in international communications, together with the Office of U.S. Trade Representative and the State Department, which is the lead agency in international negotiations. Despite its international visibility, the NTIA cannot match the FCC's domestic regulatory powers.

In addition, the Executive Branch's Department of Justice plays a major role through its Antitrust Division, which oversees much of the telephone industry by way of enforcing the 1982 court order which broke up AT&T (See discussion in text at n.27 et. seq., infra.). The primary authority in that case is federal district court Judge Harold Greene, who frequently decides whether telephone companies and other parties are complying with the AT&T divestiture decree, and who has thus become a major presence in telecommunications matters.

Conforming to a broader policy trend in the U.S. governmental decision making process, federal courts -- particularly the U.S. Court of Appeals for the District of Columbia Circuit -- have become a significant locus of telecommunications policy making. (The circuit courts hear appeals from trial courts and administrative agencies; their decisions can be reviewed only by the Supreme Court, which hears only a few percent of circuit court decisions.) For example, the

D.C. Circuit forced the FCC to allow non-AT&T equipment manufacturers to sell terminal units for connection into the local AT&T exchanges, making competition in the equipment market possible (Hush-a-Phone v. FCC, 238 F.2d 266 (D.C. Cir. 1956). The Justice Department and the Federal Trade Commission also play a role in regulating industry competitive behavior and structural changes - primarily mergers and acquisitions - and by forcing divestitures as with AT&T, (1977).

Most important for telecommunications policy, at least in theory, is the U.S. Congress. The primary legislation for U.S. telecommunications is the Communications Act of 1934. This Magna Charta of U.S. telecommunciations rarely has been amended, despite many attempts. Policymaking in light of changed circumstances has been left largely tot he FCC's and the courts' discretion. Congress often wields its power indirectly, however, by giving signals to the FCC through bills, resolutions, hearings, and the budgetary process. Congress can reduce an agency's budget unless it adopts certain policies, a position which obviously can have a strong influence on an agency.

This multiplicity of decision-making governmental bodies frustrates coordinated and comprehensive policy-making. But this process also accomodates decentralized and ad hoc decisions, many of which are responses to specific problems, rather than part of a grand design. This has permitted a fairly rapid re-orientation of U.S. telecommunications policy.

III. Ma Bell and Her Children

The U.S. telecommunications industry was a simple affair for a very long time. There was one telephone company, the American Telephone and Telegraph Company (AT&T). Despite its name, it was barred from telegraphy, which was the domain of Western Union. And internationally Western Union was excluded from the telegraph market, in favor of a handful of so-called international record carriers. AT&T was perhaps the most vertically integrated telecommunications corporation in the world, since it provided literally everything from equipment to long distance transmission to local service. Western Electric (now AT&T Technologies) produced both terminal and switching equipment; Long Lines Division (now AT&T Communication) provided ninety percent of the nations' long distance traffic; Bell Labs (the only AT&T entity to survive without a name change) did basic research, through a complex series of contracts with the other AT&T components; and 22 wholly or majority owned local telephone companies -- such as New York Telephone Company of Southern Bell -- provided lcoal exchange service to one or more states.

The divestiture ended the most significant portion of AT&T's vertical integration -- namely, the common ownership of the local exchange companies and the equipment as well as long distance service providers. At least in theory, this removed a number of perceived conflicts of interest, such as local exchange companies' paying inflated prices for Western Electric equipment.

While the Justice Department was pursuing its divestiture case, the FCC was imposing structural restraints on AT&T. The FCC found it necessary during the 1970's to decide how AT&T could provide data processing and other "enhanced" services. AT&T could provide only telecommunications transmission service under the 1956 Consent Decree. Because of the capabilities of electronic switching and of customer demand for new services, AT&T increasingly felt pressure to offer enhanced services. These services were provided at first through AT&T's common carrier offerings - over the objections of the data processing industry - and were considered communciations services. The FCC addressed this dilemma in its First and then Second Computer Inquiry. Ultimately, the Commission developed a distinction between "basic" or communications services, and "enhanced" or software-driven services. AT&T could provide only basic services through its regulated offerings. Enhanced services had to be provided by an unregulated and "fully separated" subsidiary.

In May of 1986 the Commission decided in yet another rule making proceeding, the Third Computer Inquiry, which re-examined restrictions on both AT&T's and the BOC's activities. Its new rules allow both AT&T and the BOCs to operate without the requirement of a separate subsidiary, provided certain safeguards are instituted. It also provided for the establishment of open network architecture, which will be discussed further below. The FCC reaffirmed the dichotomy of "basic" vs. "enhanced" telecommunications services.

IV. Networks of Networks

Operation of the various types of telephone networks in the united States is highly decentralized.

1. Local Service

(i) There are 22 Bell Operating Companies, such as the New England Telephone Company. They are organized into seven Bell Regional Holding Companies, such as NYNEX. The BOCs provide the bulk of local service, with more than 1,000 small independent companies serving approximately ten percent of the nation's geographic area and twenty percent of its population. The largest independent company is General Telephone & Electronics (GTE). Local companies are restricted to service within their Local Access and Transport Areas (LATAs), and may not enter long-distance or international communications. They are regulated by various bodies, primarily state commissions and the FCC.

(ii) Various private "by-passers" compete with the BOCs in providing local service through a number of technologies. These technologies include:

a. Cable television;

b. Point-to-point microwave;

c. Digital Termination Service (DTS), a two-way point-to-point switched microwave service;

d. Fiber optic links;

e. Infrared transmission, which does not require an FCC license; and

f. Cellular radio, primarily in the form of mobile car telephones.

(iii) Shared tenant services (STS), a hybrid new form of local transmission in which landlords resell local service using a private branch exchange (PBX) and lines leased from telephone companies or other carriers.

b. Long-distance Service

(i) AT&T controls more than 60% of the long-distance market and more than 80% of "interLATA" service.

(ii) Other common carriers (OCCs) such as MCI, Sprint, and ITT provide the rest of InterLATA service.

(iii) The BOCs provide, within their LATAs, long-distance service, which accounts for about 20% of national long-distance traffic.

(iv) "Resellers" of long-distance service (including in part the OCCs, which often lease lines from AT&T) and many others buy long-distance service at low bulk rates and resell it at a profit to smaller users.

(v) Lessors of long-distance links include a growing number of railroads or highway authorities, which install fiber optic lines on their routes.

(vi) Domestic record carriers, primarily Western Union and RCA, provide mostly telegraph services, and increasingly data

transmission.

(vii) Specialized companies -- including data networks and value-added networks such as Telenet and Tymnet -- provide packet switching and other high-technology services.

(viii) Satellite carriers (such as RCA), often operating as common carriers, lease transponder capacity to other common carriers and private users.

c. International Carriers

(i) AT&T provides the bulk of international voice service, and now also provides record service.

(ii) Other carriers such as MCI International and Sprint provide service to countries with whose postal, telegraph, and telephone (PTT) authorities they have agreements. In the Pacific, the Hawaiian Telephone Company handles much of the traffic.

(iii) Comsat, the U.S. Signatory to INTELSAT and INMARSAT, originally operated solely as a "carrier's carrier," and is now able to access users directly. For international civilian satellite communications (as distinguished from cable or microwave), INTELSAT was the sole link. U.S. carriers may go through either Comsat or a private carrier to access INTELSAT for international satellite service.

(iv) International record carriers (IRCs such as RCA, ITT, TRT, MCI International (formerly Western Union International) also offer telegraph and telex service. The IRCs originally were restricted to international record service. These

restrictions now have been abolished.

(v) Specialized carriers and value added carriers such as telenet use leased circuits to provide data base and related services.

(vi) Applications have been approved for new international satellite carrier systems; similarly, approvals have been granted for new trans-Atlantic cable ventures.

V. Deregulation in International Telecommunications Services

Over the past few years the FCC has also removed many of the historical restrictions on interntional telecommunications. These FCC actions include the following:

1. Elimination of the voice/record dichotomy. Until 1982, there was a sharp distinction between voice and non-voice service. The FCC allowed AT&T to provide voice service, but generally not to expand into the non-voice market. The dichotomy resulted partly from historical circumstances and partly from the FCC's concern in retaining a viable international record carrier industry. In 1982, however, the FCC ruled that any carrier could provide any service (Overseas Communications Services, 92 FCC 2d 641 (1982)). This followed a number of other decisions which gradually allowed AT&T to enter the data market and the IRC's to enter the voice market.

2. Entry of Western Union into International

Telecommunications. This was effected through the Record Carrier Competition Act of 1981, which repealed Section 222 of the Communications Act. When Section 222 was enacted, Western Union had a monopoly on U.S. domestic telegraph business, and was required to divest its international operations in order to protect the other IRC's. The Justice Department had kept AT&T out of the domestic telegraphy since the famous "Kingsbury Commitment" of 1913, under which AT&T agreed to avoid that market.

3. Entry of Additional International Carriers In 1976 the FCC authorized Graphnet and Telenet to provide international record service, thereby allowing competitive entry into international telecommunications (Graphnet Systems, Inc., 63 FCC 2d 402 (1977)). More recently, the FCC routinely has granted applications by MCI, Sprint and SBS to provide international service.

4. Extension of Computer II Rules to Provision of International Service. As noted, the FCC has increased substantially AT&T's ability to provide "enhanced services" in its Computer II and Computer III proceedings. This may have an impact on international telecommunications. Some U.S. carriers fear that deregulation of enhanced service providers would increase foreign PTT's powers in dealing with U.S. entities, and thus result in playing off U.S. companies against each other. Since service providers are not subject to FCC authorization, they could negotiate arrangements with PTTs which did not conform

to the FCC's policies for allocating costs among common carriers and BOCs. At least theoretically, an enhanced service provider thus could divert traffic and revenue from certificated U.S. carriers, and/or force them to reduce settlement rebates with the PTTs.

5. Applicability of Deregulation of Common Carriers to International Communications. During the past few years, the FCC has eliminated rate-of-return regulation for most common carriers except AT&T. In the Competitive Carrier proceeding, the Commission developed a doctrine of "forbearing" from regulation. The FCC determined that only a dominant carrier (primarily AT&T) needed to -- or would be permitted to -- file tariffs. This decision still required the filing of applications and tariffs, however, for international service.

VI. Residential Rates

One of the immediate concerns of American commentators had been the effect of the AT&T divestiture on residential subscribers. Figures of 300% increases were frequently anticipated. In absolute numbers, the figures are far less dramatic. For 1985, a table compiled by the Michigan Public Service Commission for all states found rates changes averaging $1.82 per line (business and residential) per month, or about $21.85 per year, including inflation. A study by NTIA finds that during a multi-year period up to March 1985 (and beginning, depending on the state, from 1981 to 1984), residential flat rate

(unlimited local call) service went up from $12.50 to $13.80/month median, an increase of $1.30/month, or $15.60/year. In rural areas, unlimited local calls service increased to $10.15/month (which is $3.65/month lower than the comparable urban rate). Residential budget rates in urban areas increased at the same time from $6.20/month to $7.05; in rural areas, to $6.25. In comparison, a movie ticket in urban areas will cost around $5. Lifeline service is cheaper still (depending on number of calls made). In California, it is $2.23/month for 30 calls. In New York the local company proposed a rate of $3.28/month and 10 cents per call. The predictions of steep rate increases did not take into account the working of the political-regulatory system, whose strong opposition and social concerns permits only a gradual increase in local service rates. Furthermore, social safety nets in the form of budget or "life-line" service for the needy have been introduced across the country. Finally, the rate pressure has been forcing the local telephone firms and their holding companies to discover ways of cutting costs. As will be discussed below, in particular equipment costs have dropped for the local companies as they were free to solicit competitive bids. The total result is that residential users are not likely to be as badly off as it seemed at first; but they will clearly pay more than they did before divestiture (unless they consume many long-distance calls). A strong sentiment for supporting the poor and elderly in their telephone usage is evident.

VII. Long Distance

In late April of 1986, AT&T announced a reduction of its long-distance rates for an average of 9.7%. It was the third price reduction in a little over two years, for a total of about 24%. To that, one needs to add the inflation of two years. Thus AT&T's long-distance rates were reduced by close to 30% in real terms since the divestiture. The company has been fairly successful in protecting its position, though of course, its market share had no place to go but down. Of inter-regional (inter-LATA) long-distance service, its share is 80%. MCI, the strongest of AT&T's rivals, has a share of about 8%. It has absorbed IBM's long-distance venture SBS. GTE Sprint experienced financial difficulties and merged with United Telecommunications into "U.S. Sprint." Many of the hundreds of resellers folded or consolidated their services into larger units. At present, a fierce marketing battle is taking place across the country as "equal access" is being phased in exchange-by-exchange. Questions have been raised about whether AT&T may end up again as a monopolist. This is unlikely:

(a) SBS's and GTE's difficulties have been partly management problems.

(b) The FCC is not likely to let monopoly re-emerge, even if this means handicapping AT&T to some extent, as is still the case.

(c) Effective long-distance entrants, in the long-run, may well be the seven Bell regional companies, which at present are precluded from that field.

(d) The long-run trend is for "smart" equipment to select "least-cost-routing" among several comanies. Thus, subscribers will not choose one long-distance company anymore, as they usually do now, but different calls will use different carriers.

(e) Long-distance will become a commodity business, with railroads, highway authorities, and satellite firms providing capacity for service packages put together by wholesalers.

The most important point is that even if AT&T's market share is still dominant, its prices had to come down, in real terms, by about 30%, since divestiture.

VIII. The Equipment Market

The connection of terminal equipment to the insterstate network is regulated by the Communications Act and the FCC's regulation. Part 68 of the FCC's rules sets minimum technical standards that equipment must meet in order to be connected to any public switched network.

Terminal equipment users have nondiscriminatory access to the telephone network. Equipment sellers must register their products, however, with the FCC before marketing them. Registration requires the disclosure of a unit's technical

specifications, so that the FCC's staff can identify any possible system degradation prior to installation of the equipment. But there is no approval process to go through. Today one can buy a telephone, of dubious quality, for as little as four dollars on a New York City street corner.

The U.S. market for central office (i.e., local exchange) equipment was characterized in the past by a fairly competitive situation only for non-AT&T companies. AT&T was precluded from that market, but -- perhaps as a result -- many other companies were active in it, including foreign suppliers such as Ericsson and Northern Telecom. On the other hand, the vast Bell system and all of its customers -- comprising 80% of the total market -- were foreclosed to other suppliers by its ties to AT&T's manufacturing subsidiary, Western Electric.

The AT&T divestiture radically freed the market for local exchange equipment by severing the link between the BOCs and AT&T.

Although most analysts expected the BOCs to cling to AT&T as their equipment supplier, they in fact have embraced a wide variety of non-AT&T equipment quite rapidly.

Technical network standards are coordinated for the BOCs by Bell Communications Research (Bellcore). There appears to be no sign that Bellcore is using this role to favor AT&T or other U.S. manufacturers. Neither the executive branch, the FCC, nor the state commissions has shown a desire to set standards beyond those already in place.

Procurement of network equipment by local telephone companies is governed by their obligation to state regulators to pay the lowest possible prices. Pressure is on them to keep rates low, because of the loss of subsidies fron long-distance service. The ability to compare cost trends for the 22 companies also forces them to seek low-cost equipment. The 'gold plating" (over-capitalization) of the past is unlikely to persist in today's environment. Because of the divestiture, the BOCs no longer have any incentive to increase Western Electric's profits, since none of those profits are returned to the BOCs.

The opening of the U.S. telecommunications equipment market to foreign supplers has not been matched by a reciprocal opening of foreign markets to U.S. producers, and foreign markets were affected by the high exchange rate of the dollar in the past. The U.S. balance of trade in telecommunications equipment thus has become increasingly negative, even though U.S. manufacturers have begun to sell equipment in countries such as Japan. One response to these developments had been the introduction of proposed federal legislation to require reciprocity; several bills are slowly moving through Congress. The U.S. also has exerted pressure on Japan to lower its non-tariff barriers in equipment procurement.

IX. Competition for Local Service

Competition has also emerged in local transmission, mostly

for business customers. This competition is referred to as "bypass." The FCC defines bypass as "the transmission of long-distance messages that do not use the facilities of local telephone companies available to the general public, but that could use such facilities." [FCC Common Carrier Bureau, Bypass of the Public Switched Network, Dec. 19, 1984.] Hence, the use of private lines that are leased from the local telephone company and which are not switched is included. Though such lines still leave the local telephone companies with revenue, such revenue is normally considerably lower than what they would realize through the same traffic on their public switched network. A bypass using telephone company leased lines is a "service bypass," as distinguished from the "facility bypass" using non-telco transmission parths. Service bypass will be the most prevalent form of bypass in the next few years. There are by now a good number of alternative forms of local communications available by users. The information provided below provides a somewhat technical overview of service options available in New York City. It is summarized in the table further below.

1. The basic switched voice grade circuit of the telephone companies.

2. Several categories of private data-grade lines are provided by the local telephone companies. Since 1985, telephone companies have been permitted to "raid" each other's territory for such service. (a) Direct analog data communication lines. (b) Digital Data System service (DDS) for medium speed Dataphone

usage. (c) "T" grade lines for high-capacity data transmission in computer use, with rates of up to 1.544 megabits/sec, known as the T1 rate.

3. Fiber optic links. In New York, the firm Teleport Communications, an affiliate of Meril Lynch, offers alternative fiber transmission.

4. Coaxial Institutional Cable (I-NET) has long been used for high capacity voice and data transmission and for cable television. Because of their long-standing involvement with coaxial cable technology, and given their plant and srevice personnel, some cable television companies have offered data transmission services to large business users in the areas of their franchise operations. The first such service was by Manhattan Cable in 1974, which offered customers data transmission over a trunk system that is "dedicated" and mostly physically separate from its television transmission.

5. Point-to-Point Microwave is provided by in-house systems and private microwave common carriers. In communication intensive areas such as Manhattan, the more desirable lower frequencies have been filled up.

6. Digital Termination Service (DTS) DTS is a point-to-multipoint microwave transmission technology which permits fairly small users from numerous locations to use microwave. DTS was originally developed by Xerox for its now abandoned X-TEN national office communications network, and was opened for licensing in 1981 by the FCC as the local end of a

national all-digital microwave system. DTS consists of central "nodes" that transmit and receive microwaves from all directions to and from customer-premise transceivers. These nodes in turn interconnect to each other and to long-distance carriers by point-to-point microwave. The nodes have switching capability, and their range is about six miles. The first DTS service was provided by Local Area Communications (LOCATE) in Manhattan.

7. Multipoint Distribution Systems (MDS) use multidirectional microwave for a one-way transmission of video and data. They were approved by the FCC in 1952 as a common carrier for low-power communications, and have a range of 15-30 miles. A transmitter costs about $1 million and reception equipment is about $200. Because MDS is used largely for pay-TV transmission--though this was not anticipated when the service began--lease rates for data reflect the opportunity cost of video transmission which in turn depends on the status of cable television. An MDS channel can be leased in Manhattan for $5,000 per month.

8. Satellite links connect a user directly to a communications satellite via a parabolic antenna. It has become possible to acquire fractional satellite transponders. Although a satellite is not a local distribution medium in the normal sense (though it certainly could be used as such, via a 46,000 mile hop) it integrates the local and long-distance part into one transmission, if undertaken from the user's premises. Recent technological developments in SAES (Small aperature earth

stations) make cheap on-premise uplinks feasible.

9. Cellular Radio. This technology provides a significantly more efficient usage of frequency for radio communications. As a stationary system, it is a rival to local exchange companies' basic service, particularly in rural areas.

10. Miscellaneous: Infrared or Laser Transmission, FM subcarriers (for one-way data transmission); Specialized Mobile Radio (SMR); Radio Packet Communications (RAPAC); Cable Packet Communications (CAPAC); land mobile radio; satellite mobile communications.

X. Price Comparisons for Local Service Options

Table 1

Price Comparison of Local Transmission Links

(Manhattan; leased lines or channels; 5 miles unless noted)

Transmission Medium	Price per Month (leased)	Capacity (Kilobits per second)	Price (per 1 kilobit per second transmission capacity per month)
Switched Voice Grade Circuit	117.16(a) (69.16)(b)	1.2	97.60 (57.60)
Direct Analog Data Communications	236.40(c)	9.6	24.60
Digital Data Service	373.00(c)	56	6.70
T1-grade copper line carrier	2645.26(c)	1,544	1.70
Fiber Line	950	1,544	.61
Coaxial Cable Line (I-NET)	1750(m)	1,544	1.15
Point-to-Point Microwave	1200(k) 1000	6,132 1,544	.20 .65
Digital Termination Service (DTS)	600(l)	56	10.71
Multi-point Distribution System (MDS)	5,000(j)	3,088	1.62
Satellite Transponder	110,000(d)	64,000 (max of 1,544 Kbps)	1.70
Cellular Radio	2,000 e	.3(f)	6667
Infrared	400(g,h)	1,544	.25

a. Assumes $21.16 basic business rate access charge, plus usage charge for 8 hours/day usage, 20 days/week.

b. Assume usage of 4 hours/day, 20 days/week.

c. New York Telephone.

d. Prices range from $66,667 to $150,000, depending on length of lease and preemption protection. Source: RCA Globecom.

e. $15-69 basic service depending on type of service; usage depends on peak/off peak. Assumes 4 hours peak/day; 20 days/week ($1920 usage). Equipment installed $1300-2200. Assumes 5 years life. Source: NYNEX.

f. Voice rate 1.2 Kbps.

g. Owned equipment $14,000. 5 year life; maintenance $1,000/yr. Source: Light Communications, Inc.

h. Range 3/4 miles.

i. Teleport Communications.

j. Class Y service (24 hours/day), one-way transmission only. Source: Contemporary Communications.

k. Contemporary Communications. ((1.) T2 transmission. (2) T1 Transmission.) Eastern Microwave's rate is $900 equipment, $22/mile video coverage. 6 Mbps.

l. On basis of 30% use of node ports (100 ports). Contemporary Communications.

m. Manhattan Cable.

Table 1 summarizes the information above for leased forms of local service in Manhattan. They are normalized for the price per 1 Kbps, to permit comparisons. As can be seen, microwave ($.2¢ - .65), fiber optic links, (.61), Cable Company coaxial lines ($1.15), and T1 telco carriers ($1.7Ø) are the low cost providers.

For the user, the optimal choice of communication links depends not only on the price, but also on a number of technical, economic, environmental, and regulatory variables. These include, for example, data volume, avilability of duct space, microwave paths and frequencies, lines of sight, southern exposure, order-lag of leased lines, number of origination and destination points, and desired security and reliability. It also depends on the willingness to own and maintain equipment and a network, to be served by a multi-service communication carrier, or to deal with multiple communications providers for separate services.

XI. Regulatory Issues

What bypass means is that large customers will obtain cheaper local service than residential customers, a reversal of the traditional redistribution where business customers had payed more than residential subscribers for local service. The political and regulatory pressures that such a historic change

presents are significant.

Quite typically, the largest 3% of customers of the local telephone companies account for 50% of revenues. Telephone companies are thus susceptible to major revenue loss if some of their best customers move over to bypassing, and the fixed cost of the network has to be distributed over the remaining subscribes, resulting in rate increases and further incentives to bypass or drop off the network altogether. The federal regulatory response to this problem has been to impose a flat-rate end user access charge as a partial substitute for a usage-sensitive charge on the long-distance carrier. These latter charges provided an incentive for by-pass. In New York, the local telephone company charges AT&T more than eight cents per minute for a connection, with only 3 cents per minute of costs. (Other calculations put these numbers at 7 and 4 cents, still a fair margin.) By-passer could thus be profitable even if their costs were 5 cents. Under a flat rate access charge on the user of telephone service, such incentives for "uneconomic", i.e., regulation-induced bypass, would be reduced. The FCC's policy response has been to phase in a flat-rate access fee on users, who would thus not be affected in their usage decisions. This policy has been severely criticized for shifting the burden to users and away from carriers. Congress was sufficiently aroused that the FCC postponed implementation until after the 1984 elections.

State regulators find themselves in a dilemma. As they

restrict telephone companies from providing bypass service or matching the lower prices of bypassers in their regular service, they may only accelerate the departure of large users. This has led to different responses. Some states haver permitted local telephone companies to price their services in a differentiated fashion. Others, such as California, have considered banning intrastate carrier bypass, thus taking the opposite approach.

XII. Shared Tenant Services

A trendy development of recent years are so-called "smart" office buildings which increasingly provide communications services to their tenants. This "intelligence" is becoming a selling point for office space in overbuilt markets (for example, Denver had a 24.7% office vacandy rate in 1985; Houston, 19.5%; Dallas, 17.3%; Los Angeles, 12.4%)

Smart buildings provide communications services to their tenants such as shared PBX switching and a variety of shared links to the outside. They can provide discounted long-distance telephone service, electronic mail, facsimile message service, videoconferencing, data processing and storage, and telex service. All this is provided by the building owner, or by his agent, to multiple tenants which is why such service is known as "shared tenant service" or STS.

Of particular importance for shared tenant services (STS) is that programmed PBXs have the ability to select the least-cost

route (LCR) for a long-distance call, given the time of day, destination, and traffic density. To reach long-distance carriers, shared tenant service PBXs can utilize a vareity of private lines and other links that bypass the public switched networks of local telephone companies, and which a single tenant could not afford. They have therefore been described as "reselling" local transmission service.

One reason for the emergence of STS is the recreation of one-stop telephone service. The AT&T divestiture has accelerated the move away from a fully integrated system. Local telephone service, long-distance telephone service, and telephone equipment are being provided by different suppliers. This increased complexity generates incentives for new entrepreneurs to recreate some simplicity for users by offering integrated, building-based communications packages consisting of the various components of competitive suppliers.

Residential usage of shared tenant services is also emerging, though less frequently than in an office setting.

For the landlords, the various technical, financial, legal, and maintenance problems involved may add a burden that is better shouldered by a specialized operator known as a "shared tenant services provider." Such a firm selects, installs, and maintains the PBX, negotiates with the telephone company, runs the message center, and services the telephone equipment in the building. Several of these frequently undercapitalized firms have recently experienced financial problems when the sign-up rate of tenants

was lower than expected--in some instances only 20% of a building. This has slowed the rate of introduction of STS, which is estimated to be in around 200 buildings in early 1986. However, the basic concept behind STS keeps attracting entrants.

The logic that drives STS (and LANs, as we shall see) are economies of scale, which encourage the bundling of the communications of multiple tenants. This logic does not stop at the property line of a building, but will move beyond and seek to consolidate the communication services of several buildings, and, over time, of entire areas. The first examples of such multi-building STS have just begun to emerge. Thus, clusters of STS are likely to develop in central business districts, as regulatory barriers crumble. These groupings, centered around large PBXs, will functionally be quasi-local telephone exchange companies, even if their regulatory designation may be technically different. Their emergence will establish local competition not only on the level of transmission links, which is "bypass," but also on the level of local switching services.

XIII. The Emerging Competition in Local Switching

In America, the idea of all telecommunications under one organization was never palatable. Even in AT&T's heyday, it shared the field geographically with 1500 other independent telephone companies (covering more than half the country and 20% of subscribers), and functionally with the domestic and international record carriers. Deregulation and divestiture

accelerated the segmentation of networks.

The term "segmentation" is not a negative characterization. What is meant are alternative or specialized networks, usually controlled and operated by several entities, and usually interconnecting with each other. First to emerge were private and then public alternative long-distance carriers, of which MCI, Sprint, and SBS were the largest. Their story is well known. Subsequently, rival local transmission began to take place too, known as "by-pass" service. This was accelerated by the emergence of "shared tenant services," which provide resale of local bypass service and also provide competition in local switching. These developments led to yet another and still more radical approach that is just beginning to emerge, known as "open network architecture," (ONA), similarly known as "comparably efficient interconnection," (CEI). (The former term is broader and more descriptive.) This approach is technically not incompatible with ISDN (Integrated Services Digital Networks), the priority of most telecommunications authorities in other industrialized countries. There could easily be an ISDN-ONA, and in the United States this is likely to happen. But in terms of underlying philosophy, ONA derives from a diametrically different concept of the future environment of the telecommunications networks, and of the role of the major carriers in it, than those held by ISDN's major international supporters. In its May 1986 Computer III decision, the FCC adopted the ONA concept.

Open network architecture expands the concepts of service alternatives and network fragmentation into the very core of the networks, and lowers barriers to entry for rival and varied communications services. ISDN, in contrast, is part of an effort to raise entry barriers and assure monopoly by providing a highly integrated network. ONA unbundles, where ISDN consolidates.

The "open network architecture" concept must be distinguished from the similarly named "open systems interconnection" (OSI) of the International Standards Organization which provides a definitional framework of seven broad layers of the entire network process. ONA takes this further by not only going into more detailed sub-functions of several of these layers, but also proposing their functional separation together with a business and regulatory policy concept.

Ameritech, one of the seven regional holding companies, proposed in February 1985 to the FCC a first-generation model of the new concept, named somewhat inelegantly "feature node/service interface" (FN/SI). A similar concept, though less detailed, was presented in November 1985 to the FCC by US West, another of the Bell regional holding companies, under the name of "open network architecture." A variant of ONA is also known as "comparably efficient interconnection" or CEI, the term which the FCC uses in its Computer III Notice of Inquiry when it requested comments on the concept. An operational framework for a CEI was reached in March, 1986, by three major firms with diverse interests: Pacific

Bell (carrier), IBM (equipment supplier), and Tymnet (value added provider).

ONA is a framework of disaggregating network components in such a way that permits open access; it operates on the concept that all central office functions consist of components known as "primitives", or fundamental building blocks, and that these components can be unbundled. Different communications services use different building blocks, or different configurations of them, sequenced in various ways by a routing central point (RCP). The open network architecture permits the use by outside parties (users or third-party service providers) of the building blocks of their choice. Where any of the blocks could be provided cheaper or better from another supplier, it could be substituted and combined with blocks of the local exchange company. In other words, competition would exist for the various functions of the exchange switch by unbundling its multiple functions. To make such a system work, service providers could in some instances co-locate their own "third party feature nodes" on the physical premises of the local exchange company. The third party service providers are partly a form of value added networks, competing physical networks on the local level, and partly simple resellers. In all of these functions they would compete head-on with the local exchange companies who act both as retailers and as wholesalers of these services.

Through ONA/CEI, the local exchange company would permit the resale of separate parts of its services, down to separate

functions of the local exchange. This is a radical reversal of past practice, where the monopolistic telephone companies tried to prevent resale. Now, the local exchange companies are recognizing that their network is their greatest asset, and that they should sell its capabilities as much as possible, to the point of encouraging the use by outsiders. In this fashion, the network would be more highly utilized, and the telephone company could profit.

Rather then fight competing local bypass service, the local exchange companies aim to benefit from also using it to become more unregulated. Indeed, the desire to become deregulated in local exchange functions is the motivating force in these proposals, and raises problems for the regulators.

Most immediately, the companies are striving to be freed from the restrictions of the Computer II Inquiry rules. The BOCs desire to offer enhanced services, (and, in the future, be free to provide long-distance service.) Under Computer II, however, this was possible only through the cumbersome device of fully separated subsidiaries for these services, in order to prevent cross-subsidies from the monopolistic and regulated basic services to the competitive services. The ONA/CEI concept substitutes a functional technical separation for the organizational-legal one. Once the building blocks are separated from each other, a pricing mechanism can be put into place that can establish transparent and non-discriminatory pricing for all, whether they are re-sellers or the local exchange company

itself. For those building blocks where a true competition exists, deregulation could be instituted. Elsewhere, tariffed rates would be set.

Another reason for the open network architecture concept for the companies is to move to a more flexible environment in their own equipment and software procurement. At present, central office switches are highly integrated equipment, and their operation depends on extraordinarily complicated software. Thus, the local exchange companies are largely dependent on their switch suppliers, mostly AT&T and increasingly Northern Telecom, to modifty the software for new functions. A modular approach of separated functions has operational as well as economic advantages. New services could be introduced more flexibly by adjusting equipment and software modules, or by substituting them through shopping around in a competitive market.

In technical terms, the ONA/CEI approach is not contradictory to ISDN since an ISDN operator could similarly provide for the subdivision of its functions, selling them separately and permitting various reconfigurations and resale to third parties. This is likely to happen in the U.S. in the future. But, attitudinally, the ISDN concept as presently held by its champions abroad is widely different. While the open network architecture is another step in the fragmentation of American networks, the PTTs purpose for ISDN is another step in its centralization.

The ONA concept, for example, makes it clear that third

party access and use will be provided to the common channel signaling. This is important, because many of the sophisticated communications functions and operations are greatly facilitated by that channel, and the exclusive control of the dominant common carriers over it as an internal housekeeping channel constrains their rivals. In the ISDN context, ONA would thus provide access to the D- channel. In the European ISDN context, the signalling D- channel is not being offered for user access in the same way that the B- channels are.

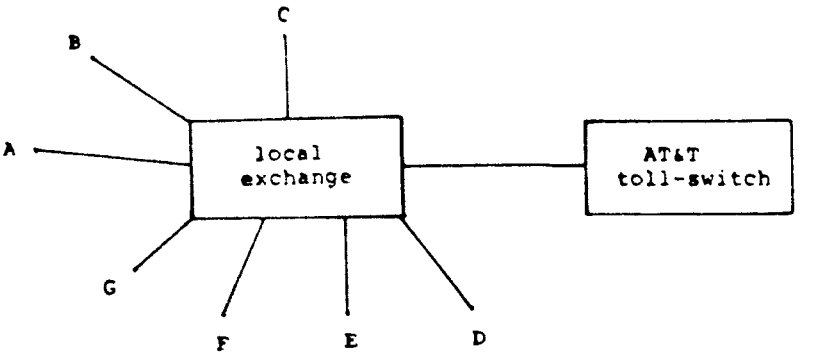
ONA/CEI are not the only move of fragmentation in central office switching. For some time, customer-owned PBXs provided a vigorous competition to central exchange switching, particularly to the "Centrex" service of local telephone companies. In consequence, several states, led by Iowa, have deregulated Centrex-type service. This development was accelerated by "shared tenant services," by which multiple users share a common (non-partitioned) PBX.

Another step in the direction of competition in local transmission and switching comes from AT&T, technically precluded from local service by the Divestiture decree. AT&T is moving back, nevertheless, in two ways. First, it establishes local bypass in transmission by setting up of leased facilities to give end-users direct access to AT&T's long-distance switches. In New York, this is done over the fiber optic lines of an independent carrier, Teleport Communications. More interesting is AT&T's move into local switching under its Software Defined

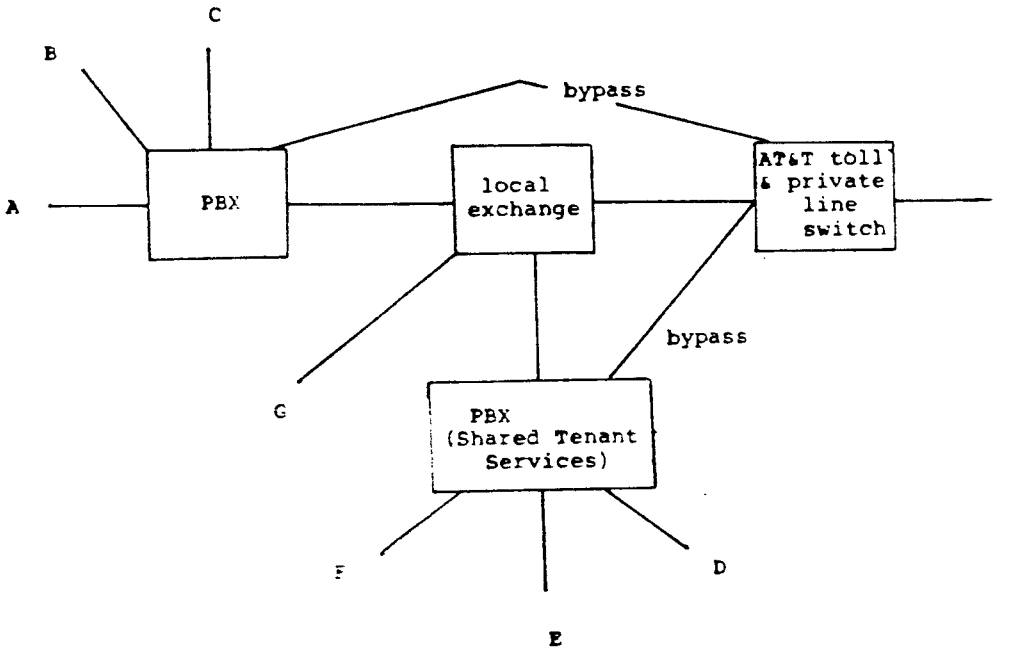
Network (SDN). Under this system, AT&T links customers in a tie-line network and permits them to switch their calls in the AT&T toll switch. For example, the internal network of a company's site A, concentrated by a PBX, is linked by bypass service to AT&T's toll switch, from where it is moved to the company's sites B and C in other locations. PBXs at B and C route traffic to their destination according to a programmed dial plan. What this means is that in this network, any terminal can reach any other terminal without ever using the local exchange companies or their public switched network. It is clear that this system can be taken one simple step further--in technical terms--with the AT&T toll switch connecting also between <u>different</u> users who have tie-lines to the AT&T switches, and also <u>within</u> the local exchange area itself, omitting the trunk transmission portion. This would make AT&T's toll switch, together with customer PBXs, into an alternative system of local switching. This can be illustrated in the attached Figure 1.

Figure 1

a) Traditional centralized local switching



b) Competitive local switching



In Section (a) terminals A-G are interconnected through the local exchange in the conventional way. In Section (b), terminals A-C and D-F are interconnected to each other by PBXs. This is frequent for internal networks, but shared tenant services (STS) move it also into the interconnection of unrelated parties, and potentially entire clusters of buildings. The PBXs, in turn, can be interconnected in two ways: first, to the regular local exchange, partly in order to access a user of type G. But in addition, they also can link to the AT&T toll switch, which can switch them with or without toll transmission (at least in technical terms; regulation may be a roadblock). Thus the local exchange has now competition from the two directions. For user clusters A-C and D-F, it has internal and STS- PBXs as rivals to its service. And for connections between those clusters, it has AT&T/s "toll" switch as a competitor. A switched call could thus be made from user A to user F entirely outside the local exchange.

XIV. ISDN in the United States

In the U.S., equipment manufacturers share a similar interest in the sales potential of ISDN as their European counterparts. Similarly, the major carriers (AT&T, the Bell Operating Companies, and the largest independent telephone companies) see ISDN as a strategic move to enhance their

competitive position. However, the reality of ISDN operations in the United States is complicated by the presence of multiple carriers, all with different timetables for the introduction of ISDN; this is likely to lead to the development of ISDN "islands," and to varying service features. Technical coordination takes place in the Exchange Carriers Standards Association (ECSA) and its T1/D1 subcommittee, which makes non-binding recommendations. One item of contention is the treatment of the different long distance carriers under ISDN. AT&T with its common channel signalling has an advantage in inter exchange ISDN, which creates problems for equal access to local exchanges.

The development in the United States towards ISDN began in the early 1960s, when AT&T introduced the T1 carrier system and the 1-ESS electronic switching system. T1 carriers operate on a 1.544 megabit/sec., with 24 channels of 64 kbit/sec. (This, incidentally, creates another coordination problem with European countries, whose standard is 2,048 kilobits/sec., and 30 channels.)

Fully digital communications were made available for a number of years by Satellite Business Systems (SBS), partly owned by IBM and later sold to MCI after years of financial losses. Another digital "ISDN" system is that of Argo, a small communications company owned by Centel, Alltel, and France Cable et Radio. (The latter participation is interesting, because it introduces a foreign telecommunications participation in entity

the American long-distance market.) Argo has created a network with operating nodes in several cities, from which it provides national and international service. The company has called itself the first ISDN in the world, which is somewhat of an exaggeration, since it is not an ISDN along the definitions of the CCITT. Argo has only a single 56 kilobits/sec. channel (instead of the two 64 kilobits/sec. plus 16 kilobits/sec signaling channel of CCITT ISDN) and its signaling operates through regular telephone line access.

Similarly, ITT Telecom has introduced a concept called USDN--for United States digital network for digital traffic processing through existing central offices.

There have also been <u>private</u> ISDN networks. A sophisticated example for such a private network is that of Boeing, spanning three continents.

The AT&T divestiture accelerated the introduction of digital switches, since it mandates equal access by 1987, which is easier to accomplish for the BOCs with digital switches. Furthermore, central office equipment cost fell rapidly for the BOCs, as they became free to solicit competitive bids from other manufacturers. Among the Bell companies the most advanced ISDN project is in Chicago, where Illinois Bell, Belcore, and AT&T are conducting in 1986 the first American full-scale ISDN field trial, with regular service anticipated for mid-1987.

It turned out to be difficult in the United States to agree on standards for the "U" interface. Basically two techniques can

be used, one known as "ping-pong" (or transition code modulation, TCM), employing alternative burst transmission in opposite directions. A second method is the echo cancelling (EC) approach in which data is transmitted simultaneously from both directions, but the system can separate and distinguish them from each other.

Efforts which began in June 1984 in a US subcommittee decided to prefer the echo cancellation (EC) technology, rather than the time compression multiplexing (TCM), after one year of study. But several firms were intent to go ahead anyway with TCM development. [Comments of the Ameritech Operating Companies to the Federal Communications Commission in the Matters of Third Computer Inquiry, Nov. 13, 1985, CC Docket no. 85-229).

XV. Outlook

Whether American-style "segmentation" or PTT-type "super-integration" are optimal solutions for networks is a matter that cannot be determined *a priori*. It is a classic trade-off of several economic principles: the efficiency of specialized production and of a competitive environment, versus the productivity contributions of economies of scale and scope and the reduction of uncertainty. One cannot generalize on what works better. For telecommunications networks, however, an empirical answer should be available in the near future.

When the AT&T divestiture was announced, U.S. critics, and with them many European observers, interpreted this event as a victory for AT&T, which had shed, it was believed, the sluggish and regulated parts of its business and gained the rights to teh world of the future, the new information technology. This interpretation disregarded the long fight that AT&T had waged to preserve its end-to-end vertical integration, which was the cornerstone of its corporate philosophy; it was ignorant, as most observers still are, of the FCC's Computer II decision, which, preceding the divestiture by about a year, had opened competitive markets to AT&T under a structurally separated subsidiary. And it was simply wrong-headed in believing that a giant monopolist would do well in the new world of competition. So far, the experience has been sobering for AT&T in the equipment field, in particular in the computer field.

It is important not to confuse the health of AT&T with that of American telecommunications. The infrastructure is alive and well, and a glance at the trade press with its torrent of announcements of services, products, ventures and market entrants shows the extraordinary and feverish vitality that characterizes all parts of communications. Indeed, it is precisely the vitality of this process that will undermine the economic rationale for the divestiture, namely to separate the competitive and monopolistic sectors of telecommunications from each other. As this artificial institutional separation crumbles under technological reality and from the regulators' desire to give

local exchange companies new sources of revenue for rate relief in residential and rural telephony, the AT&T divestiture may increasingly become a mere size-reduction of a giant firm, into a set of mini-AT&Ts, coupled with liberalization, and less of a functionally targeted and elegant economic separation that its Justice Department originators had envisioned. Indeed, Judge Green is at present busily trying to stem this tide. These efforts demonstrate that the lessons of the past -- the futility of structural solutions in a dynamic environment -- have not been learned.